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Dominion

May 25, 2010

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

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|---|---|
| Serial No. | 10-321 |
| NSSL/MLC | R0 |
| Docket No. | 50-423 |
| License No. | NPF- 49 |

**DOMINION NUCLEAR CONNECTICUT, INC.**
**MILLSTONE POWER STATION UNIT 3**
**SECOND REPORT REGARDING LEAD TEST ASSEMBLY**

In a letter dated December 16, 2004, and supplemented on October 5, 2005, Dominion Nuclear Connecticut, Inc. (DNC) requested an amendment to Facility Operating License NPF-49 to revise the burnup limit to allow one Lead Test Assembly (LTA) to be irradiated during Millstone Power Station Unit 3 (MPS3) Cycle 12. The NRC subsequently approved this request on December 30, 2005, as Amendment 228. In the December 16, 2004 letter, DNC committed to provide two reports to the NRC associated with the high burnup LTA. The first report was submitted to the NRC in a DNC letter dated March 6, 2007 (Serial No. 06-894). The information requested in the second report is provided in Attachments 1 and 2 of this letter. Based on these submittals, the commitments made to the NRC in the December 16, 2004 letter are complete.

If you have any questions, please contact Wanda Craft at (804) 273-4687.

Very truly yours,

J. Alan Price
Vice President – Nuclear Engineering

Commitments in this letter: None

Attachments:

1. Second Report Regarding Lead Test Assembly
2. Westinghouse Post-Irradiation Examination Report

cc: U.S. Nuclear Regulatory Commission
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# ATTACHMENT 1

# SECOND REPORT REGARDING LEAD TEST ASSEMBLY

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3

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## Licensee Name

Dominion Nuclear Connecticut, Inc.

## Plant Name

Millstone Power Station Unit 3

## Assembly Identification Number

Next Generation Fuel Assembly (NGF) Lead Test Assembly (LTA) M71

## Summary of Pre-Characterization Inspections and Post Irradiation Examinations, As Appropriate

The post-irradiation examination report for the MPS3 End of Cycle 12 High Burnup NGF LTA M71 is provided in Westinghouse Electric Company LLC (Westinghouse) Report PPE-09-162-NP, dated March 3, 2010 (Attachment 2).

# ATTACHMENT 2

## <u>WESTINGHOUSE POST-IRRADIATION EXAMINATION REPORT</u>

**DOMINION NUCLEAR CONNECTICUT, INC.**
**MILLSTONE POWER STATION UNIT 3**

Westinghouse



# Post-Irradiation Examination (PIE) Report
# Millstone 3 End of Cycle (EOC) 12 High Burnup Next Generation Fuel Assembly (NGF) Lead Test Assembly (LTA) M71 PIE Report (Non-Proprietary)

Customer: Dominion

Plant and Unit: Millstone Unit 3

Date: March 3, 2010
Our ref: PPE-09-162-NP

Distribution: Robert J. Buechel, Michael Y. Young, Jeffery L. Bradfute, PE Managers, PPE Personnel, Julia M. Leonelli, Diana B. Robinson, PE Engineers


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## Executive Summary

The inspection of high burnup NGF LTA M71 that operated during Cycles 10, 11, and 12 at Millstone Unit 3 was performed to obtain fuel performance data on the fuel assembly. The objectives of the examinations were to obtain fuel performance data on the optimized ZIRLO™ cladding material and to confirm the satisfactory performance above 60 gigawatt-days (GWD)/metric ton units (MTU). The work was performed between May 18, 2009 and July 1, 2009. Note that Cycle 12 ended in October 2008, and the NGF LTA was permanently discharged after End of Cycle (EOC) 12.

The discharged assembly average burnup was above 60 GWD/MTU (high burnup NGF LTA M71 was the center assembly in the core in Cycle 12).

The observations and measured data were consistent with expectations in the following areas.

1. Fuel Assembly Visuals,
2. Fuel Assembly Growth,
3. Fuel Rod Growth,
4. Grid Oxide,
5. Grid Growth,
6. Fuel Assembly Bow,
7. RCCA Drag,
8. Fuel Rod Oxide
9. Fuel Rod Profilometry and Ovality
10. Grid Cell Size/Grid-to-Rod Gap, and
11. Fuel Rod Visual, Eddy Current, and Wear Depth Examinations

The Eddy Current (EC) system did not detect any grid-to-rod fretting wear.

## 1.0 Introduction

High burnup NGF LTA M71 operated in Cycles 10, 11 and 12 at Millstone 3. The Westinghouse NGF fuel assembly is a 17x17 array utilizing the standard 0.374 rod diameter with added features designed to maximize fuel duty capability, reliability, and flexibility of operation. The NGF design is fully compatible with the RFA fuel and plant handling equipment.

The cladding and structural components were fabricated with optimized ZIRLO™ to provide margin to corrosion, growth and creep. Low tin ZIRLO™ was an incremental improvement over ZIRLO™ and a significant improvement in oxidation, hydriding, and creep and growth rates over Zircaloy-4. The examination plan is shown in Table 1.

**Table 1: Examination Plan**

| **Examination** | **Scope (Assemblies) Rods** |
|---|---|
| Half-face visuals on all 4 faces | M71 |
| Shoulder Gap | |
| Rod Bow | |
| FA Bow | |
| RCCA Drag | |
| Guide Tube Length | |
| Grid Oxide | (Grids 2, 3, 4, 5, 6, and 7)<br>M71, Faces 1 and 2 |
| Grid Width | Grids 2, 3, 4, 5, 6, and 7 |
| Fuel Rod Cleaning | (M71) Rods E15, C13, E13, I13, M14 |
| High Mag Visuals | |
| Fuel Rod Growth | |
| Fuel Rod Eddy Current | |
| Wear Scar Depth | |
| Fuel Rod Profilometry | |
| Fuel Rod Oxide | |
| Grid Cell Size | |

The Cycle 10, 11, and 12 core locations of the high burnup NGF LTA M71 are shown in Figure 1. The examined rods were the rods with the highest predicted oxide results.

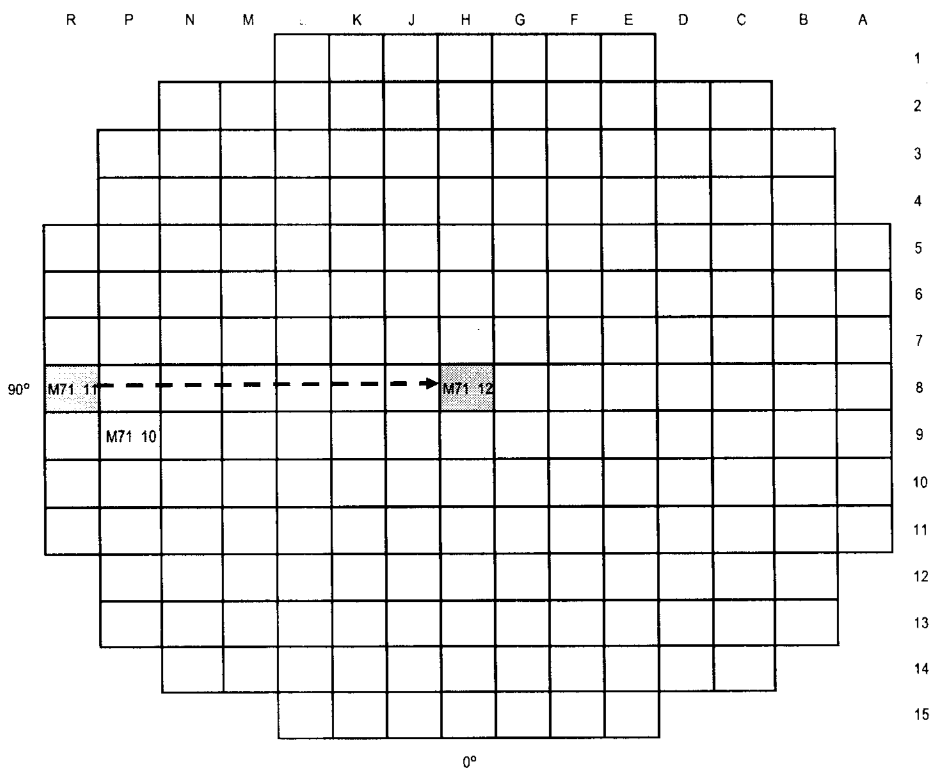


**Figure 1: Cycle 10, 11 and 12 Core Locations of High Burnup NGF LTA M71**

## 2.0 Fuel Assembly Examinations

Seven different examinations (fuel assembly visuals, fuel assembly growth, fuel rod growth, grid oxide, grid growth, fuel assembly bow and RCCA Drag) were performed on the fuel assemblies.

## 2.1 Fuel Assembly Visuals

This examination was performed to assess the overall mechanical integrity of the examined fuel assemblies. The visual inspection was performed using a pole-mounted, high-resolution underwater color camera. The fuel assembly was inspected in an open spent fuel pool cell. As shown in Table 2, no anomalies were observed during the fuel assembly visual examination.

**Table 2: High Burnup NGF LTA M71 Fuel Assembly Visual Examination Results**

| Inspection | Face 1 | Face 2 | Face 3 | Face 4 |
|---|---|---|---|---|
| Top Nozzle | | | | |
| Adapter Plate? | Straight | Straight | Straight | Straight |
| Top Nozzle Rod Gap | | | | |
| Uniform? | Yes | Yes | Yes | Yes |
| Rod End Cap Welds? | No anomalies | No anomalies | No anomalies | No anomalies |
| Grids | | | | |
| Torn? | None | None | None | None |
| Tabs? | No anomalies | No anomalies | No anomalies | No anomalies |
| Crud? | No anomalies | No anomalies | No anomalies | No anomalies |
| Damage? | None | None | None | None |
| Debris? | None | None | None | None |
| Assembly Channels | | | | |
| Bowed Rods? | None | None | None | None |
| Debris? | None | None | None | None |
| Bottom Nozzle | | | | |
| Debris? | None | None | None | None |
| Fuel Rods | | | | |
| Hydride Blisters? | None | None | None | None |
| Handling Damage? | None | None | None | None |
| Crud? | No anomalies | No anomalies | No anomalies | No anomalies |
| Other Anomalies? | None | None | None | None |

## 2.2 Fuel Assembly Growth

Fuel assembly growth was measured to ensure that the growth of high burnup NGF LTA was within the experience data base and below the design limit. The stainless steel guide tube probe was used to measure the fuel assembly growth in the spent fuel pool (SFP). The growth was determined by calculating the difference between the standard as-built and the measured data.

The measured growth was well within the Westinghouse experience data base and below the design limit.

### 2.3 Fuel Rod Growth

Fuel rod growth data were obtained to confirm that optimized ZIRLO™ fuel rods contain adequate rod growth margin and to ensure that enough shoulder gaps exist, even at very high burnup. The axial gaps between each peripheral rod and the assembly top nozzle were measured to determine the fuel rod growth data. The nominal data from drawings were used to determine the pre-irradiated rod length for the rod growth calculations.

The measured growth was well within the Westinghouse experience data base and below the design limit. There were sufficient shoulder gaps at the end of three cycles of irradiation.

### 2.4 Grid Oxide

This examination was performed to measure the oxide thickness on the grids. The grid oxide data were obtained while the oxide measurement fixture was on top of the SFP racks. The Eddy Current lift-off technique was used to measure oxide thickness. In the measurement technique, the fuel assembly was suspended from the spent fuel pool handling tool and a grid clamp was used to hold the fuel assembly in place during the measurement process.

The measured oxide data for all grids were well within the Westinghouse experience data base and below the design limit.

### 2.5 Grid Growth

The grid growth data were obtained to evaluate the performance data on the design. The grid growth data were obtained while the measurement fixture was on top of the SFP racks. The system used the ultrasonic transducers to obtain data. In the measurement technique, the fuel assembly was suspended from the spent fuel pool handling tool and the fixture clamp was used to hold the fuel assembly in place during the measurement process.

The measured growth data for all grids were well within the Westinghouse experience data base and below the design limit.

### 2.6 Fuel Assembly Bow

The EOC 12 fuel assembly bow was measured from the underwater camera system video of the fuel assembly in the SFP.

The measured fuel assembly bow data were well within the Westinghouse experience data base.

## 2.7 RCCA Drag

RCCA drag was measured in the SFP with a special tool that was used to grip the RCCA hub. A load cell and a signal conditioner were used to measure the drag, and the data were recorded on strip chart recorder paper. The RCCA drag was determined from the data by correcting the tool weight, RCCA weight, and buoyancy.

The measured RCCA drag data were well within the Westinghouse experience data base and did not exceeded any IRI threshold guidelines.

## 3.0 Rod/Grid Cell Examinations

Subsequent to the non-intrusive fuel assembly inspections reported in Section 2, the rod/grid cell examinations were accomplished by removing the top nozzle from the assembly and removing the appropriate fuel rod in the fuel assembly. The rods were visually examined with a high magnification camera to determine rod wear indications during the EC inspection. After the visual inspection/single rod EC inspections, single rod oxide and single rod profilometry data were obtained on most of the fuel rods. Grid cell size data were obtained prior to re-inserting the fuel rods into the fuel assemblies.

## 3.1 Fuel Rod Oxide

The purpose of these examinations was to assess the corrosion on the optimized ZIRLO™ fuel rods from NGF LTAM71. The Eddy Current lift-off technique was used to measure oxide thickness.

The measured fuel rod oxide data were well within the Westinghouse experience data base and below the design limit.

## 3.2 Fuel Rod Profilometry and Ovality

The purpose of these examinations was to determine the rod diameter of the examined NGF rods. The data are used to determine the grid-to-rod gaps (discussed in Section 3.3). There were no direct criteria associated with the profilometry data.

The profilometry system consisted of a measuring head, the Motorized Fuel Rod Handling Tool (MFRHT), a standard with known diameters, and a computerized data acquisition system. The measuring head contained two Linear Variable Differential Transformers (LVDTs) mounted perpendicular to the rod's longitudinal axis and oriented 90 degrees apart. The results were adjusted for oxide thickness.

The measured rod diameter and ovality data were well within the Westinghouse experience data base.

### 3.3 Grid Cell Size/Grid to Rod Gap

The purpose of these examinations was to determine the cell size in the NGF LTA grid cells. This data, along with the fuel rod profilometry data, is used to calculate the grid-to-rod gap dimensions. The grid cell size measurements were determined from the drag measurements that were obtained by withdrawing three step pins through a designated grid cell. The drag load from each step on the step pin was measured at each grid within a cell. The measured drag load and the step pin sizes were used to calculate the cell size by determining the size that would result in no load.

The measured rod grid cell size data were well within the Westinghouse experience data base.

### 3.4 Fuel Rod Visual, Eddy Current, and Wear Depth Examinations

The purpose of these examinations was to assess the wear on NGF fuel rods. The Eddy Current data was the principal means for evaluation of this parameter.

Fuel Rod Eddy Current Measurement Technique
The data was collected while the fuel rod was withdrawn from the coil. The extent of the examination was from the rod tip to a rod elevation that included part of the plenum area. The EC analysts reviewed the data by looking for anomalous data indications. The system used absolute and differential EC probes.

High Magnification Rod Visuals
Single rod visual examinations were performed with a high-resolution color camera mounted above a spent fuel storage rack. The rods were moved in front of the camera using the rod-handling tool. Three to four orientation scans were made on the examined fuel rods. During the scans, the rods were initially positioned to view wear marks from either two dimples or two springs. During the scan, special attention was paid to determine if grid wear had eliminated the rod loading scribe line. If needed, the rod was rotated to determine if the rod loading scribe line was present and if shiny metal from fretting wear was present on the fuel rod.

High Magnification Rod Visuals, Wear Scar Depth and Eddy Current Results
The visual, EC and Wear depth examination did not detect any appreciable rod wear.

### 4.0 Conclusions

The assembly visuals, assembly growth, rod growth, grid oxide, RCCA drag, fuel assembly bow, grid width, grid cell size, grid-to-rod fretting wear, and fuel rod oxide were consistent with the Westinghouse experience data bases. The EOC 12 data were significantly less than the Westinghouse design limits. The EC system did not detect any grid-to-rod fretting wear.